

Implications of Actions by the Board of Supervisors Regarding Regulation of Genetically Engineered Crops in San Luis Obispo County

Report of the Committee for the Evaluation of Growing Genetically Engineered Crops in San Luis Obispo County

Prepared for Bob Lilley, San Luis Obispo County Agricultural Commissioner

The following is an introduction to the Implications Table, and should not be read as an Executive Summary of our committee work. The Implications Table is presented as a means of defining the questions surrounding production of Genetically Engineered (GE) crops in San Luis Obispo County.. There are social, moral, and ethical differences in the way GE crops are viewed. As a committee we have tried to avoid discussing these differences at a broad level and instead have attempted to capture them in specific topics associated with agricultural production, economics, the environment, health, and regulatory and legal issues.

We have found it important to remember that actions by the Board of Supervisors, or by the voters, will only have impacts to crops produced within our County, and on lands under county jurisdiction. We have framed our discussion in this way.

The following table does not attempt to assign probability of risks or benefits from production of GE crops. It does attempt to define those issues where committee membership had diversity of opinion. For some, the risks of genetic engineering outweigh the benefits; for others the benefits outweigh the risks.

Available science is limited to address many of these issues. Where possible, committee members have identified additional sources of information regarding individual topics. Those resources are identified both in the comments below each issue as well as at the end of the table.

The committee realized that it was nearly impossible to come to a traditional consensus about what the Board of Supervisors (BOS) should do. What the members of the committee did feel equipped to do was to highlight the specific concerns that different stakeholders had regarding the control of such production. By doing so, we would enhance the ability for the Agricultural Commissioner, the Board of Supervisors and the community to focus discussion on those areas where disagreements occurred and why those disagreements arose. In essence, we are “framing” the question or questions as best we can and hoping that, as a result, public discourse will focus on the issues and not on the personalities of those with strong positions on those issues.

In organizing the table, the committee highlighted a number of areas and questions that one or more members felt was important. Not everything brought forth was included for reasons of time and expertise, but there was a consensus as to what issues are presented here. For most of the issues presented, we tried to characterize the issue or concern in a general way (the first column of the matrix) and then, in most cases, we tried to tease out the implications of different actions that could be taken by the BOS. To make the matrix consistent and easy to follow, the committee characterized five actions that the BOS could take. In characterizing the five actions, the committee is NOT telling the BOS what they should do; rather, we are trying to highlight what might happen IF the BOS took a particular action.

Again, for ease of understanding, the committee came up with five (5) cases that explore the implications of actions addressing a particular issue or concern. The five cases are as follows:

- Case 1: Board chooses to take no further action with respect to the GE crop issue;
- Case 2: Board directs the development of suggested guidelines for San Luis Obispo producers, processors and handlers of genetically engineered crops;
- Case 3: Board approves action for the case-by-case review and approval of genetically engineered crop production;
- Case 4: Board temporarily prohibits production of genetically engineered crops; and,
- Case 5: Board permanently prohibits production of genetically engineered crops.

Definitions:

Case 1: Board chooses to take no further action with respect to the GE crop issue.

The Board chooses not to take action on a critical issue. In such a case, growers will have the choice to determine if they want to grow GE crops or not. If they do, growers can self-regulate their production practices.

Definitions (cont.):**Case 2: Board directs the development of suggested guidelines for San Luis Obispo producers, processors and handlers of genetically engineered crops.**

A decision would have to be made as to who will develop and distribute suggested guidelines as well as who will be responsible for updates to guidelines as new information develops. In addition, the following questions would have to be answered:

- What county departments would be involved and how would tasks be assigned?
- Is funding available to cover staff's time, equipment, and space?
- What crops will be covered?
- How long will the process take?

In developing voluntary guidelines, the following issues could be addressed:

- Producers considering growing GE crop taking into account neighboring organic and conventional farmers;
- Informing farmers of actual risks with *existing* GE crops and the theoretical risks and industry promises of newly developed crops
- How does the consumer know products have been produced under voluntary guidelines?

Case 3: Board approves action for the case-by-case review and approval of genetically engineered crop production.

Almost all the issues presented in Case 2 are also relevant in this case. In many respects, it is more difficult to develop and enforce a case-by-case or crop-by-crop approach because of the lack of uniformity across crops and/or locations. Approve on a crop-by-crop basis might enhance approval productivity..

The first question to be considered is whether the Board will be the authority that approves the action to review and approve production of GE crops. If so, what process will be used? Will the process fit with the existing protocol for BOS review of staff reports. If so, , what County departments will present each case? Would this action require that the board study each individual crop or would each individual producer have to be studied? Is funding available to cover staff's time?

Examples exist of guidelines/protocols addressing GE crops that SLO County could use as a model. Without reference to efficacy, examples include:

- Boulder County, Colorado¹;
- North Dakota;
- Hawaii has formed a co-existence committee;
- Marketing orders in California such as the California Rice Commission²; and,
- The organic industry has a list of strategies³ to follow.

Case 4: Board temporarily prohibits production of genetically engineered crops.

This case, aside from suffering from some of the same cost and enforcement issues raised in the previous cases, buys time for all involved in many respects. First of all, it buys time for more public input and education. Secondly, some economies could be achieved in administering this decision since no GE crops would be allowed to be grown for the duration of the moratorium. Thirdly, the moratorium would allow the Board time to identify key issues for long-term actions with contributions from staff, the public as well as outside experts. Finally, there would be time for the Board, farmers and any other interested parties to research and observe actual results of new GE crops outside San Luis Obispo County.

Case 5: Board permanently prohibits production of genetically engineered crops.

A ban on the production of genetically engineered crops does not prevent a non-SLO grower from selling GE crops in San Luis Obispo County. Neither does it prevent the consumption of such crops by county residents. This case would close the door on any possible positive profitability resulting from GE crop production in the county. On the other hand, the farming community would possibly be protected from any potential problems (foreseen or unforeseen) arising from GE crop production.

¹ <http://www.co.boulder.co.us/openspace/advisory/gmotac.htm>

² <http://www.cdffa.ca.gov/mkt/mkt>

³ http://www.newfarm.org/archive/index_2002.shtml; search for feature article in August 2002 – Contamination protection: 10 ways to minimize GMO contamination

HOW TO READ THIS TABLE:

The committee worked to negotiate the language included under each potential action, identified by case. Committee members had agreed at our first meeting that capturing both majority and minority opinions was important in this process. We accomplished this by including comments from committee members under case descriptions for each identified issue.

Within each case description there may be comments from the committee regarding potential impacts of Board action on the current situation in our county, and/or comments on the potential impacts of Board actions. In either case we have attempted to include comments that pertain to both the consumer and producer. We have also included comments for both conventionally and organically produced crops.

For some issues, the committee did not feel qualified to determine what the potential impacts might be of BOS decisions. In these cases we tried to include comments for consideration when addressing the particular topic.

Acronyms used:

Bt	<i>Bacillus thuringiensis</i>
CCOF	California Certified Organic Farmers
FDA	Food and Drug Administration
GE	genetically engineered
GMO	genetically modified organism
IPM	Integrated Pest Management
SLO	San Luis Obispo
UCCE	University of California Cooperative Extension
UCS	Union of Concerned Scientists

Several Committee participants felt it important to include comments that framed their interests in this issue. These comments are included below:

SLO GE Free:

Keeping San Luis Obispo County free of genetically engineered crops is good for our health and good for the economy.

Genetic engineering, an experimental method of developing new organisms that uses a virus or bacteria to insert the DNA of one species into another, is a new technology and unlike any other previously practiced methods of plant breeding. Foods with GE ingredients have been on our grocery store shelves for only seven years and have yet to be thoroughly tested for human safety.

The foundation of genetic engineering – the idea of one gene for one trait – is based on the 50-year-old belief that DNA is the sole blueprint of life and the remaining 98% of genes is “junk” DNA. However, recent discoveries have shown that “junk” DNA plays a major, but little understood, role in the health and development of an organism. People in other parts of the world are aware of the shortcomings of using GE research to create human food, and refuse to buy products made with genetically engineered ingredients.

Since international markets and now more and more national markets refuse to buy GE, remaining free of these experimental genes will give our county an economic advantage. Conventional and organic crops sell for between 2 and 7 times the price of GE counterparts nationally and internationally. In the United States, companies from Silk to Frito Lay to McDonald's are proud of serving GE free foods.

SLO has a very diverse agricultural sector. We have moved into the new century with the opportunity to expand our quality products to a larger SLO audience, increased domestic markets, as well as the international arena. The uncontrolled aspect of GE crops through contamination (gene flow) by pollen or seeds of conventional crops by means of wind, animals, trucks and post harvest mixing endangers all our local agriculture. Buffer zones and other suggested means of isolating GE crops from conventional crops have failed in many instances. SLO GE Free thinks our county should not risk a prosperous and growing local agriculture for a new and experimental technique that remains unproven for health or profitability.

Farm Bureau:

Farm Bureau policy supports biotechnology as well as organic farming.

California Certified Organic Farmers (CCOF):

CCOF believes that a substantial amount of caution must be exercised with respect to allowing the production of any sort of GE crop in the county. Accepting that there is no clear consensus with respect to much of the science, it is imperative that the organic agricultural market be protected in the short-, medium- and long-run. The organic sector is far outpacing the conventional agricultural sector in terms of growth and has the potential to provide more and broader economic opportunities for conventional growers wishing to transition to organics or wishing to diversify their production to include organic crops. The maintenance of these opportunities relies on maintaining the confidence that consumers and processors and handlers (both inside and outside the county) have in the purity of organic production. If enough consumers believe that the organic production coming out of San Luis Obispo County is contaminated in some way, or if processors and handlers of SLO organic production believe that their customers may also be concerned about contamination issues, then a hard-won reputation is lost and undoing the damage could take a very long time. As long as SLO County organic production is believed to be pure, then opportunities for ALL growers are maintained substantial.⁴.

⁴ This may lead to the desire to establish a "SLO-Grown" label (which would be used to either imply that the crop is GE-free or that SLO is a county which prohibits the production of GE crops and is highly unlikely to suffer from gene flow problems (but this won't fit on a small label). This niche of "SLO-Grown" would be open to organic and non-organic growers alike and would need to be supported by an aggressive campaign by growers/county ag commissioner that "SLO-Grown" is based on regulations which prevent GE crops from being grown in SLO. [CCOF]

Issue or Concern	Potential actions by Board of Supervisors				
	Case 1	Case 2	Case 3	Case 4	Case 5
AGRICULTURAL		Voluntary guidelines	Case-by-case	Moratorium	Ban
Impacts to profitability (productivity, inputs, etc)	<u>Potential</u> Consumer: NA Producer: Conventional – could remain status quo; Organic – Could also remain status quo	<u>Potential</u> Producer: Conventional - Increased costs for plant material, increased yield and quality, loss of production choices from adherence to guidelines; decrease in production costs/inputs. Organic – See organic sections	<u>Potential</u> Producer: Conventional - Increased costs for plant material, increased yield and quality, greater loss of production choices from regulation ; Organic – See organic sections	<u>Potential</u> Producer: would remain status quo for the term of the moratorium Organic – Could also remain status quo	<u>Potential</u> Producer: Conventional – could remain status quo; Organic – Could also remain status quo
<p>Comments:</p> <p><u>Committee:</u> Assuming only costs and impacts to producer in this section – no pest management inputs or market access issues considered here. Impacts to non-GE operations not considered. Largely associated with “input” GE (benefits primarily to growers)</p> <p><u>GE Free:</u> Since our top ten crops do not have a track record for GE varieties, we have nothing to look at regarding the relative success of these crops over their non-GE counterparts. However, we can look at the track record of industry claims versus field performance of other GE crops that are being grown. Initially higher yields and lower costs were predicted for GE varieties of soybeans and corn. However field measurements have contradicted these claims^{i ii}. Reduced nitrogen fixation may explain the reduced yields seen in glyphosate resistant soybean. Glyphosate applications in young soybean delayed nitrogen fixation.ⁱⁱⁱ The growing rejection of GE crops by export markets has caused sales to decline for GE crops^{iv}. After years of seeking approval to sell GE Bt-11 corn in the European Union, Syngenta has decided not to sell this corn in the EU due to consumer resistance to GE.^v There are also greater consumer concerns domestically over GE horticultural crops compared to agronomic crops.</p> <p><u>UCCE:</u> Most of the available GE crops have been engineered with pest resistance or herbicide tolerance, not for yield improvement. The term yield drag refers to the reduction in yield of GE varieties as compared to conventional selections.</p>					

Issue or Concern	Potential actions by Board of Supervisors				
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AGRICULTURAL		Voluntary guidelines	Case-by-case	moratorium	Ban
Impacts to integrated pest management programs, including pesticides (insecticides, herbicides, fungicides, acaracides); resistance management	<p><u>Potential</u> Consumer: NA</p> <p>Producer: Conventional- change in herbicide types and use and insecticide use with resistant crops or increase with resistant pests; reduced hand weeding; choices limited by contract</p>	<p><u>Potential</u> Consumer: NA excluding turf</p> <p>Producer: Producer: Conventional-Voluntary guidelines to outline pest management approaches; change in herbicide and insecticide use; weed species shift; use of seed mixtures to manage resistance; resistance management and resistance monitoring costs. Producers may need to meet contractual obligations regarding pesticide, refuges, and buffers when using GE crops Organic – see organic section</p>	<p><u>Potential</u> Consumer: NA excluding turf</p> <p>Producer: Conventional-Identify sources of pest management information; change in herbicide and insecticide use; weed species shift; use of seed mixtures to manage resistance; resistance management and resistance monitoring costs; Producers may need to meet contractual obligations regarding pesticide, refuges, and buffers when using GE crops Organic – see organic section</p>	<p><u>Potential</u> Consumer: NA</p> <p>Producer: Conventional and organic – see organic section Allows time for assessing contractual requirements for GE crops.</p>	<p><u>Potential</u> Consumer: NA</p> <p>Producer: Conventional and organic – see organic section</p>

Comments

Committee: GE crops may be regarded as a tool in an IPM program, but may limit choices for varied response to pest pressure and may have implications for resistance management.

UCCE: This discussion may be assuming SLO has no new insect or disease issues – remembering we already have Pierce’s Disease in the county but weak vectors limit spread. Current GE crops (not grown here) with pest management implications include crops with herbicide tolerance, insect (Bt), and viral or bacterial resistance. There are case studies of the impacts of GE-crops on pest management programs (National Center for Food and Agriculture Policy) as well as studies on monitoring for development of resistance to Bt crops by USDA-ARS (Anon, 2003; Hardee et al. 2001). Impacts to pest management programs need to be assessed on a crop-by-crop basis. Changes in herbicide and pesticide use has been shown to vary according to crop, location, and management, much as they do with conventional non-GE varieties. Evidence of herbicide tolerance and weed shifts are most prominent in crop rotation systems where multiple herbicide tolerant crops are used in the rotation (e.g. corn/soybean rotations).

GE Free: We have no data on GE varieties of the top SLO crops. However, with genetically engineered agronomic crops, herbicide use has significantly increased with herbicide tolerant GE crops. This in turn has led to the development of herbicide resistance in weeds^{vi}. Weeds resistant to three of the worlds best selling herbicides were found in the canola fields of Canada.^{vii} This in turn has led to the development of herbicide resistance in weeds^{viii}. While pesticide use has gone down with Bt corn and cotton varieties, there are concerns over the development of pest resistance to Bt and recommended management strategies include the use of traditional pesticides or the planting of non-Bt refuges. After 24 generations of selection on transgenic broccoli, diamondback moths could complete their entire life cycle on transgenic broccoli expressing high levels of Bt toxin.^{ix}

Issue or Concern	Potential actions by Board of Supervisors				
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AGRICULTURAL		Voluntary guidelines	Case-by-case	moratorium	Ban
Impacts to <u>producer</u> choices (both GE and non-GE; new crop choices)	<u>Potential</u> Producer: Conventional – Access to new variety selection; Organic or Conventional non-GE – GE crop production may impact crop choices	<u>Potential</u> Producer: Conventional – Voluntary guidelines for “good neighbor” practices for new products addressing public concerns; Access to new variety selection; Organic or Conventional non-GE – GE crop production may impact crop choices	<u>Potential</u> Producer: Conventional – Access to new variety selection; delay (short-term) or reduction in choices Organic or Conventional non-GE – GE crop production may impact crop choices	<u>Potential</u> Producer: Conventional – Limitations on new variety selection; Organic – status quo	<u>Potential</u> Producer: Conventional – Limitations on new variety selection; Organic – status quo
Comments <u>GE Free</u> : “Since 1992, the U.S. branch of the industry has grown by over 20% per year; in California, average annual growth in organic sales between 1992 and 1998 was 15%. [...] California represents a significant share of the U.S. organic production. In 1997, California had 51% of the country’s organic tomato acreage, 77% of the organic lettuce acreage, 72% of organic tree nut acreage, 96% of organic grape acreage, and 80% of the organic rice acreage.” ^x After years of seeking approval to sell GE Bt-11 corn in the European Union, Syngenta has decided not to sell this corn in the EU due to consumer resistance to GE (iv). With the rise in organic markets in the US and the collapse internationally of GE markets for traditional farmers, there is an economic advantage for SLO to remain “GE Free”. Research has shown that the co-existence of GE crops with non-GE and organic will be extremely difficult to achieve. The reputation of being “GE Free” could add significant value to all of our crops <u>UCCE</u> : Released GE varieties include Soybeans – not grown here; Corn – no data that grown here; Canola - not grown here; Cotton – not grown here; Potato – all seed sources pulled 2001; Squash/zucchini – Asgrow currently produces seed, no data that grown here; Papaya – not grown here; Tomato – FlavrSavr not likely; Sugarbeets – not grown here; Rice – not grown here (HT); Flax – not grown here; Radicchio – not grown here					

Issue or Concern	Potential actions by Board of Supervisors				
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		Voluntary guidelines	Case-by-case	moratorium	Ban
ECONOMIC IMPACTS					
Market Protection How can the Board give the appropriate signals to market participants that the issue has a potential to affect the market? Do they wish to take action to, at a minimum, not hurt the market and, at a more positive level, can they enhance the market for SLO-produced agricultural crops.	<u>Current</u> Consumer: None Producer: We have no “protected” markets <u>Potential</u> Consumer: None Producer: No action by Board will give impression that no problem exists or that Board can’t influence this GE crops may provide protection for crops from disease & infestation (Pierce’s disease & Sudden Oak Death); agriculture may develop protocol & co-existence guidelines	<u>Potential</u> Consumer: Need for consumer assurance of production under guidelines Producer: same as Case 1; Markets are protected only insofar as adherence to guidelines are believed by consumers and processor/handlers.	<u>Potential</u> Consumer: Stronger assurance of production under guidelines Producer: Processor/handler may demand assurance that GE crop production was reviewed and approved.	<u>Potential</u> Consumer: Temporary assurance of no GE crops grown on county lands. Producer: Stronger case can be made to processor/handler during period of moratorium. May lose protection for crops from disease and infestation (Pierce’s Disease, Sudden Oak Death); May put our producers at a competitive disadvantage with counties/states that allow GE crops.	<u>Potential</u> Consumer: Permanent assurance of no GE crops grown on county lands Producer: Markets for which GE crops are a concern are protected. Clear rules/sanctions exist. May lose protection for crops from disease and infestation (Pierce’s Disease, Sudden Oak Death); May put our producers at a competitive disadvantage with counties/states that allow GE crops.
Comments <u>Farm Bureau:</u> Evidence to date shows that Gm crops have co-existed with conventional and organic crops without significant economic or commercial problems. From: Co-existence in North American agriculture: can GM crops be grown with conventional and organic crops? by Graham Brookes & Peter Barfoot, PG Economics Ltd. UK. June 7, 2004. http://www.pgeconomics.co.uk .					

ECONOMIC IMPACTS					
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<p>Market Reaction and Reputation</p> <p>Market reaction is the tendency of consumers and processors/handlers to alter their buying practices in response to the GE issue.</p> <p>Market reputation addresses what producers can do to improve or mitigate the changes in the buying practices of consumers and processors/handlers.</p> <p>In both of these market situations (the first being demand side and the other being supply side), actions do not necessarily have to be based on fact, they may simply address perception on the part of consumers and processors/handlers.</p>	<p><u>Current</u> Consumer: Awareness of GE crops increased. Producer: Dilemma of convincing people that crops are GE-free with raised consumer awareness.</p> <p><u>Potential</u> Consumer: Potential changed awareness may change buying practices, pro or con. For example, there may be a loss of consumer confidence in local conventional production being GE free but consumer can still purchase organic if they want ge free and assume no problems with gene flow into organics.</p> <p>Producer: Loss of processor/ handler confidence in local food being GE free. Producer able to decide how to respond to market reaction, may have to take additional efforts to distinguish GE-free production from other county production which is not differentiated. If perception that organic is GE-free, then organic growers have a niche market (reputation) for GE free products. If perception does not occur, then SLO would have no reputation to boast</p>	<p><u>Potential</u> Consumer: Guidelines may open conventional production to a GE-free market reputation; guidelines add one more assurance for consumer that products are GE-free; Same as 1 except demand for “proof” of following guidelines (without requirements for official documentation);</p> <p>Producer: Given lag in guideline development unclear as to how markets will react. No way to “prove” that guidelines are being followed once they are established. If perception of organics being free of gene flow does not occur, then SLO would have no reputation to boast.</p>	<p><u>Potential</u> Consumer: Potential changed awareness may change buying practices, pro or con.</p> <p>Producer: Conventional and organic increasingly share GE-free market; Individual crops could be marketed as “GE Free” but County-wide reputation would not exist. Reputation better protected compared to case 1 or 2. Opportunity to assess value of GE-free designation in terms of reputation and increased profits vs. possible benefits. Producer’s choice in crop selection could be reduced with potential gain or loss on competitive advantage relative to non-SLO County producers.</p>	<p><u>Potential</u> Consumer: Potential changed awareness may change buying practices, pro or con, but short term benefits may occur if consumers believe that moratorium is being followed and enforced</p> <p>Producer: Weak protection of processor/handler confidence in GE free local foods. Producers choice could be reduced with potential gain or loss on competitive advantage Conventional and organic increasingly share GE-free market compared to case 3 during moratorium; Reputation better protected compared to case 3. Opportunity to assess value of GE-free designation in terms of reputation and increased profits vs. possible benefits.</p>	<p><u>Potential</u> Consumer: Potential changed awareness may change buying practices, pro or con, but long term benefits may occur if consumers believe that ban is being followed and enforced</p> <p>Producer: Strong protection of processor/handler confidence in GE free local foods. Producers choice could be reduced with potential gain or loss on competitive advantage Conventional and organic share GE-free reputation and market</p>

Comments

Committee: Issues of “perception” vs “reality” are critical to the discussion of both market reaction and market reputation.

Farm Bureau: How will consumer and produce react if GE crops are available to buy or grow locally?

Ag is used to “scares” such as Sudden Oak Death and BSE. Certain markets come to a halt until confidence is regained. Nothing new to agriculture.

Actions taken by the Board would only affect county controlled lands and so questions regarding what constitutes “GE FREE” may arise (e.g. commercial farm lands in the City of Arroyo Grande, Cal Poly farm)

CCOF: Assumptions: Market reactions will be consistent; but problem of difficulty of changing initial reactions (whether based on fact or perception or whether based on honorable intent or not); Market reaction cannot be “managed” except to mitigate a “crisis”

The banning of GM crops from SLO would be equivalent to creating a “new” set of products that communicate (based on fact or simply based on perception) that SLO agricultural products do not have the potential to become adulterated (at the field level) by genetic drift.

ECONOMIC IMPACTS					
Issue or Concern	Potential actions by Board of Supervisors				
	Case 1	Case 2	Case 3	Case 4	Case 5
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Organic product marketing Organic product marketing is largely governed by federal (and international) regulations, GE crops do not directly affect certification (See Organic Certification Snapshot). On the other hand, the presence of gene flow can make it difficult or impossible to market the crop to buyers if the buyers know drift has occurred or if it is likely.	<u>Current</u> Consumer: no effect Producer: has marketing niche <u>Potential</u> Consumer/Producer: Heightened awareness of gene flow could jeopardize marketing of all local organic products. Certification for organic implies GE Free niche market which cannot be shared by conventional production.	<u>Potential</u> Consumer/ Producer: Heightened awareness of gene flow could jeopardize marketing of all local organic products. Certification for organic implies GE Free niche market which cannot be shared by conventional production.	<u>Potential</u> Consumer: Heightened awareness still jeopardizes marketing but the case-by-case approach potentially makes it MORE difficult for consumers to figure out which organic harvests and crops are vulnerable to gene flow issues. Producer: Review of individual cases would have to address potential gene flow issues in order to protect organic production.	<u>Potential</u> Consumer/ Producer: Increased confidence in organic products being free of gene flow from GE crops, but not long-term certainty.	<u>Potential</u> Consumer/Producer Highest level of confidence in organic products being free of gene flow from GE crops, but not long-term certainty.
Comments <u>Committee:</u> Current organic certification precludes production of GE crops, providing a market niche. However, with a ban the GE free market niche is open to both conventional and organic producers. <u>CCOF:</u> Anything that substantially reduces the chance of such contamination from occurring will ease the marketing concerns and potentially differentiate the crop from other organic crops that don't have the same protections. <u>GE-Free:</u> 50% of organic produce is grown in California. Having SLO crops contaminated with GE varieties could cause SLO to lose an economic advantage in the rapidly growing organic market segment.					

ECONOMIC IMPACTS					
Issue or Concern	Potential actions by Board of Supervisors				
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Conventional product marketing	<p><u>Potential</u> Consumer: can choose organic</p> <p>Producer: GE-Free crops might provide new choices/new markets; With increased awareness of GE crops, there may be an INCREASE in concern over the “quality” of conventional crops – could hurt local consumption market. If no action taken and there is heightened awareness of gene flow, conventional producers could NOT participate in the “GE-free” market niche that organic produce occupies. Conventional producers can take independent action to establish GE-free status.</p>	<p><u>Potential</u> Consumer: same as Case 1</p> <p>Producer: With voluntary guidelines, still very difficult for conventional crops to share GE-free niche.</p>	<p><u>Potential</u> Consumer: same as Case 1</p> <p>Producer: With case-by-case authorization, some specific crops may start sharing GE-free niche but sharing of niche would be of limited use because of the ease of confusion (and little visible difference) between a GE crop and the same crop which is non-GE and conventional. Easier to check but still problematic for consumer without labeling.</p>	<p><u>Potential</u> Consumer: same as Case 1</p> <p>Producer: With moratorium, have temporary situation in which conventional crops can EASILY be part of GE-free niche. In fact, it would strengthen the overall niche (for both organic and conventional) since there would be an overall reduction in the potential incidence of gene flow.</p>	<p><u>Potential</u> Consumer: same as Case 1</p> <p>Producer: Overall ban would strengthen the overall GE-free market niche (for both organic and conventional) since there would be a long-term reduction in the potential incidence of gene flow.</p>

<p>Comments</p> <p><u>Farm Bureau:</u> Conventional agriculture may choose to voluntarily establish methods for proving GE-Free status to build market confidence regardless of Board action.</p> <p><u>CCOF:</u> Generally, there is technically no concerns for conventional product marketing if gene flow does not become an issue but once it does, there is little to protect the conventional (but non-GE) marketing. This issue is heightened if the crop is for export or for high-end products. Big opportunity for market differentiation</p> <p><u>GE Free:</u> With the collapse internationally of GE markets, there is an economic advantage for conventional farmers to remain “GE Free”. The reputation of being “GE Free” could add significant value to all of our crops.</p>

ECONOMIC IMPACTS	
Issue or Concern	Potential actions by Board of Supervisors
Product labeling The FDA sets voluntary guidelines that require labeling of GE foods if the food is significantly different from its traditional counterpart, different nutritional property or if it includes an allergen that consumers would not expect to be present.	Comments <u>Farm Bureau:</u> Will need to follow FDA Voluntary Guidelines or current laws & regs. Not until a GE crop is on the market then the producer can market their particular product. Labeling of GE crops is on a voluntary basis and regulated by the FDA. The FDA has set guidelines to prevent false or misleading label statements. Some terms/statements may be misleading if the word "free" is used, if it implies that the labeled food is superior to foods that are not so labeled, and suggesting that a food is not ge when there are no marketed ge varieties of that category of foods (example: labeling a can of green beans as not produced using biotechnology when there are no ge green beans on the market). Can organic foods have label statements to the effect that the food was not produced using biotechnology? The FDA believes that the practices and record keeping that substantiate the "certified organic" statement would be sufficient to substantiate a claim that a food was not produced using bioengineering. http://www.cfsan.fda.gov/~dms/biolabgu.html <u>CCOF:</u> Labeling only matters if a label exists. If label exists, then potentially substantial impact (but also need for monitoring to maintain strength of label). Assumptions: Label issue arises for Cal Poly growing of GE crops but value of label is not necessarily affected – especially if Cal Poly implements a protocol for growing GE crops in contained environment (Neal has started talking to some Cal Poly professors about such a protocol)

Issue or Concern	Potential actions by Board of Supervisors
ENVIRONMENTAL	
Gene flow	Comments: <u>UCCE:</u> Pollen movement and gene flow are not necessarily synonymous. Successful pollination must take place for genetic material to move from one plant to another. Things to consider when evaluating the potential for both pollen flow and gene flow: environmental conditions (temperature, humidity, wind), degree of relatedness between the crop plants and wild relative, distance between the GE crop and non GE crops or wild relative; synchronicity of reproductive cycles; tendency to self-fertilize; the length of time pollen is viable (for example, rice pollen is viable for 10 to 15 minutes) crop pollen must fertilize the egg of the non GE plant, and non GE plant must produce hybrid seeds that are fertile and produce offspring. Potential for gene flow should be evaluated on a crop-by-crop basis. Evidence exists with some crops to indicate this does occur, but the degree varies from crop to crop, or from crop to wild relative. Rieger MA <i>et al.</i> (2002) <u>CCOF:</u> The black box revolves around the physical impacts of gene flow. Allowing GE crops increases the chance (to an unknown degree) of gene flow both the type that has been discovered and the kind that is potentially out there but not, yet, identified. <u>GE Free:</u> Seeds of traditional crops are contaminated with DNA from genetically engineered (GE) crops according to Gone to Seed, a new Union of Concerned Scientists (UCS) report. Laboratory testing of traditional (non-GE) seeds of corn, soybeans, and canola commissioned by UCS documents the presence of DNA commonly used in commercial GE crops. ^{xi}

Issue or Concern	Potential actions by Board of Supervisors
Unintended/unknown consequences; permanence of GE presence; purity of local production	<p>Comments</p> <p><u>Farm Bureau:</u> For the producer: If no action is taken by the Board this does not mean that growers will not take preventative measures; isolated cases; new state/fed regs/protocol</p> <p><u>GE Free:</u> Do not know what is or will be grown in the county; Do not know real consequences due to inadequate research “... the U.S. government provides very little post-market oversight of biotech foods. A recent report by the U.S.-based Pew Initiative on Food and Biotechnology (cited above) questions the ability of the government’s weak monitoring and enforcement systems to detect unexpected human health and environmental problems and ensure compliance with regulatory requirements. In fact, the current "don’t look, don’t find" approach to monitoring is likely to detect only the most dramatic, highly visible effects.”^{xii}</p> <p><u>CCOF:</u> The key issue here is the nature of irreversibility. If impacts are reversible in some meaningful (short-term) way, damage can potentially be undone. Keep in mind, though, that market impacts of these impacts are separate – it is much harder to undo the market damage even if the physical damage can be undone. Another issue revolves around what constitutes “contamination” – it matters what the tolerance level is. Zero tolerance is VERY problematic (even the Europeans don’t have zero tolerance) – but, again, the market implications could complicate this.</p> <p><u>UCCE:</u> There is little research-based information currently available on long term impacts. Some information including Stotzky’s work is becoming available. Saxena D Stotzky G (2001) <i>Bacillus thuringiensis</i> (Bt) toxin released from root exudates and biomass of Bt corn has no apparent effect on earthworms, nematodes, protozoa, bacteria, and fungi in soil. Soil Biology and Biochemistry, 33 1225-1230.</p>

Issue or Concern	Potential actions by Board of Supervisors
Wildlife impacts	<p>Comments</p> <p><u>Farm Bureau</u>: No solid data to confirm</p> <p><u>UCCE</u>: Lumpkin (Washington State University) raises issues related to wildlife and pharming with food crops (See Lumpkin 2003) but presents no example cases.</p> <p><u>GE Free</u>: “... the U.S. government provides very little post-market oversight of biotech foods. A recent report by the U.S.-based Pew Initiative on Food and Biotechnology (cited above) questions the ability of the government’s weak monitoring and enforcement systems to detect unexpected human health and environmental problems and ensure compliance with regulatory requirements. In fact, the current "don’t look, don’t find" approach to monitoring is likely to detect only the most dramatic, highly visible effects.”^{xiii}</p>
Changes in biodiversity – agriculture and ecosystem	<p>Comments</p> <p><u>UCCE</u>: Need to separate out potential impacts to agriculture from impacts to ecosystem – evidence of ag impacts from conventional hybridization – no evidence of impacts to ecosystem.</p>
Impacts to non-target organisms	<p>Comments</p> <p><u>UCCE</u>: Laboratory studies conducted with Monarch butterfly larvae looked at effects of larval feeding on pollen-dusted leaves. Pollen sources included control (no pollen), pollen from non Bt corn and pollen from Bt corn. Larvae consuming Bt pollen were more adversely affected than those that did not (‘adverse affects’ is the appropriate term to use, since feeding on Bt treated material does not necessarily result in larval death). A review of impacts of Bt pollen to non-target species (Sears MK <i>et al.</i> 2001) found that Monarch females preferred egg-laying host is milkweed in non-cropped areas, pollen shed from Bt corn in most areas of the country does not occur simultaneous with larval feeding, and pollen density needed to kill larvae varies with distance from the edge of fields.</p>

Benefits to the environment	<p>Comments:</p> <p><u>Farm Bureau:</u> Increase yield on less land; less pesticide use; less air pollution; less energy; improve soil health Other California counties recognize ge crops as a tool to address air quality http://www.valleyairorg/farmpermits/applications/cmp/cmp_list.pdf</p> <p><u>UCCE:</u> Direct seeding (seeding into undisturbed soil with no prior seedbed preparation) and consequent reduced tillage associated with herbicide resistant crops has been shown to reduce soil erosion, increase carbon sequestration, reduce fuel use (Cook, 2003).</p>
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Issue or Concern	Potential actions by Board of Supervisors
HEALTH IMPLICATIONS	
Food Safety	<p>Comments</p> <p><u>Health Department:</u> Concerns exist about the uptake of “promoter” genes from bacteria or viruses in foods. To date neither food nor human health differences have been shown. Further study is necessary.</p> <p>Concerns about horizontal gene transfer from foods to humans are also raised. However: a) digestion breaks down most proteins and DNA; b) rats fed large quantities of DNA exhibit no observable consequences; c) Humans have eaten foods, and thus their proteins and DNA, for millennia but few have taken on the characteristics of the foods we eat (5). Antibiotic resistance genes in foods are a concern, but the majority of gut bacteria resistance is due to indiscriminate antibiotic use in human health care and animal husbandry.</p> <p><u>Farm Bureau:</u> No evidence that ge crops pose more of a risk than conventional foods do. All GE crops must now be permitted for human consumption (StarLink). Pharma crops need extra regulations – debate about using food crop. Health – GE crops improvement on the nutritional values</p> <p><u>UCCE:</u> Current debate in the literature regarding pharming (field production of food crops genetically engineered for production of non-food products) - See Lumpkin 2003.</p> <p><u>GE Free:</u> The scientific underpinnings of risk assessment and risk management are chronically and severely under funded. Compared with the amount of U.S. taxpayer funds spent on biotech product development and related research, very little is earmarked for research on risks of engineered products. For example, in the 11-year period of 1992 to 2002, the USDA spent approximately \$1.8 billion on biotechnology research and approximately \$18 million on risk-related research.^{xiv}</p> <p>Corporations developing GE crops – who perform a majority of the safety testing – have also not been forthcoming in sharing negative results with regulators. Monsanto has refused a request by the German government to hand over a study showing that rats fed a variety of Monsanto GM maize suffered serious health abnormalities, claiming it is “confidential business information”. The study, carried out by Monsanto, found that rats fed with MON863 suffered a number of abnormal effects in the development of blood cells and vital organs, including the kidneys.^{xv}</p>

Issue or Concern	Potential actions by Board of Supervisors
<p>Allergens</p>	<p>Comments</p> <p><u>Health Department:</u> A major health concern about GE foods is the possibility of unknowingly creating or enhancing allergens via the introduction of new proteins or carbohydrates. Inadvertent creation of allergens or toxins is not limited to GE plants, but also occurs by classical breeding technologies , and likely also by same species transgenic manipulations. Introduction of unmodified “natural” Kiwi fruit to U.S. markets in the late 1960s was associated with unexpected cross-reactions with latex rubber. This suggests that natural selection, classical breeding techniques, and GE food creation may show no differences in the relative risk of introducing potential new allergens. Conversely, GE could be used to reduce or eliminate specific allergens. For example, “knockout” of the P24 gene in soy leads to absent antibody responses in persons allergic to soy, who are then fed this product. P34 is responsible for 75% of soy allergies, but 15 other proteins also contribute. Other allergen “knockout” work focuses on wheat, peanuts, and milk.</p> <p><u>Farm Bureau:</u> No allergic effects have been found relative to GM foods currently on the market. <i>World Health Organization</i> http://www.who.int/foodsafety/publications/biotech/en/20_questions_en.pdf</p> <p><u>GE Free:</u> “It is easy to test for known allergens. [...] But if the potential allergen is new, its allergenicity cannot be established or disproved with any standard test.^{xvi}” Since no human studies have been performed, we cannot be certain that no new allergens are present in GE pollen or crops. A recent study has indicated the possibility of new allergens but so far the GE producer, Monsanto, denies the claim.^{xvii} ^{xviii} Many features of genetically modified food crops, for example, impacts of stacked genes and unresolved issues about Bt allergenicity, raise concerns that have simply not been adequately investigated.^{xix}</p> <p><u>UCCE:</u> Food and airborne allergens: Available information indicates there could be both benefits and risks: Herman EM <i>et al.</i> (2003) Genetic modification removes an immunodominant allergen from soybean. <i>Plant Physiology</i> 132 36–43. Airborne issues more difficult to identify. Inferences regarding pollen allergens from Bt crops have been based on experiences with conventional Bt pesticide applications (Environmental Health Perspectives).</p>

New sources of medications	<p>Comments</p> <p><u>Farm Bureau:</u> Banning would prevent any new GE technology with the potential to offer new & affordable medications.</p> <p><u>GE Free:</u> A ban in SLO County would have no effect on developing GE pharmaceutical crops – even at Cal Poly – or the planting of these crops outside of SLO County.</p>
Rapid Technological Change	<p>Comments</p> <p><u>GE Free:</u> Genetic engineering is an evolving science. In the past few years, scientists have discovered that DNA – assumed to be the blueprint of life – plays only a partial role in determining the characteristics of an organism.^{xx} The very basis of GE crop technology – the idea of one gene for one trait – may be fundamentally flawed and the assumptions made that assume the technology is safe should be re-examined.</p> <p>In addition, natural breeding techniques coupled with gene analysis can result in crops with similar traits to GE varieties.</p>

Issue or Concern	Potential actions by Board of Supervisors				
	Case 1	Case 2	Case 3	Case 4	Case 5
		Voluntary guidelines	Case-by-case	moratorium	Ban
REGULATORY/LEGAL ISSUES	These issues are independent of consumer and producer issues and are more strictly Board related				
Enforcement Authority Current regulatory authority of GE crops lies outside the County’s jurisdiction, until the Board chooses to become involved in take action in regulation of GE crop production.	Regulation of GE crops remains outside the County’s jurisdiction.	Regulation of GE crops remains outside the County’s jurisdiction. County Ag Commissioner (CAC) has no legal authority, but would likely be involved in the process of educating growers about any voluntary guidelines developed.	Enforcement could be complicated depending on both crop and location of production. Work load could be reduced since only certain identified “cases” (likely a specific type of crop) would be regulated. Complications could arise for GE seed suppliers, who could be confused since some GE crops could be allowed and others might not.	CAC would have the authority to enforce a blanket prohibition on GE crops during the moratorium period.	CAC would have the authority to enforce a blanket prohibition on GE crops.

Comments

Ag Commissioner: There are numerous valid questions regarding the enforcement of GE crop prohibition if a ban was enacted.

1. Who is going to pay for enforcement (another unfunded mandate?)?
2. How are we going to determine if the prohibition is being followed? e.g. GE crops don't look any different from their conventional counterparts. Are we going to randomly test crops for GE gene markers? Are we going pressure the companies not to sell in SLO County? Are we going to rely on the farmers themselves?
3. What are the penalties of violating the prohibition?
4. Are we going to be pre-empted by State or Federal law in the foreseeable future?

CCOF: If there is nothing to enforce, it is easy. If there are PARTIAL enforcement issues (not generic across all farmers) then enforcement becomes more difficult than a broad-based, single authority.

Farm Bureau: State – marketing orders may have some authority to control production (eg.g. California Rice Commission protocol); County – Local marketing organizations could develop guidelines for production; Company – technical use agreements control crop production; there is also the potential for self regulation at the state or county level – co-existence guidelines.

GE Free: The County Ag. Department would be the enforcement authority. However, since all GE seeds and crops are considered intellectual property they are meticulously tracked by the owning corporations. All growers must sign contractual agreements stating where crops will be grown and the corporations have the right at any time to test owner's fields.^{xxi} As a result, it will be relatively easy for these corporations to simply follow the law and not sell product or enter into contractual agreements with growers to grow these crops in SLO county. It is important to remember that, like any other criminal activity, 100% prevention is impossible. It is possible that farmers could “smuggle” seeds across county lines and/or lie about where they are growing the crops.

Also, if SLO County was a “GE Free” county, entities buying produce here would most likely want GE Free crops, pay a premium for them, and as a result, will be verifying that the crops are indeed “GE Free”.

As a final protection, the County Ag. Department could implement random testing of final produce. Until a violation was found, there would be absolutely no need to enter a farmer's field or trespass on private property to enforce GE restrictions.

Issue or Concern	Potential actions by Board of Supervisors				
Types of Enforcement Costs discussed in the follow section:					
<i>Outreach/Education:</i> whether the regulation of GE crops in SLO County is voluntary or mandatory, temporary or permanent, there would need to be an educational outreach to both farmers and seed suppliers informing them about guidelines, rules, and/or regulations.					
<i>Evaluation:</i> if GE crops were regulated on a case-by-case basis, each GE crop proposed for production in SLO County would have to undergo a case study evaluation. This evaluation would entail researching issues specific to the proposed GE crop, e.g. determining the potential for gene flow to nearby crops and related weedy species.					
<i>Monitoring:</i> activities and techniques necessary to ensure that GE regulations are followed. Likely activities would include: maintaining dialogue with seed companies and growers on potential GE crop production, random sampling of produce for GE “marker” DNA, routine field monitoring for the most likely GE crops, etc.					
<i>Enforcement (Investigation):</i> costs associated with enforcing any potential violations of GE crop regulations, including responding to complaints or tips of a violation of GE crop restrictions, sampling suspected GE crops or products for “marker” DNA, implementing the civil penalty process, etc.					
	Case 1	Case 2	Case 3	Case 4	Case 5
		Voluntary guidelines	Case-by-case	moratorium	Ban
Enforcement Costs	Regulation of GE crops remains outside the County’s jurisdiction, thus no local enforcement costs.	Regulation of GE crops remains outside the County’s jurisdiction, thus no local enforcement costs. Potential for staff time diverted from other projects in order to conduct grower outreach and education on voluntary GE guidelines	Evaluation costs of GE crops would be higher than in Case 4 or 5 since each crop proposed for production in SLO County would potentially be treated separately. However, since it’s likely that fewer crops would be regulated if they were approved on a case-by-case basis, Monitoring and Enforcement costs would be reduced and overall costs would likely be lower than in Case 4 or 5.	It is very difficult to accurately estimate the costs needed to enforce a temporary ban on GE crops. If farmers were relied upon to voluntarily comply with a ban, then Monitoring and Investigation costs could be kept low. However, in implementing a full-scale enforcement program, with GE testing protocols and civil penalties for violations, Monitoring and Investigation costs would be substantially higher. Education and Monitoring costs incurred during a moratorium period could be lost if the ban is ended.	It is very difficult to accurately estimate the costs needed to enforce a permanent ban on GE crops. If farmers were relied upon to voluntarily comply with a ban, then both Monitoring and Investigation costs could be kept low. However, in implementing a full-scale enforcement program, complete with GE testing protocols and civil penalties for violations, Monitoring and Investigation costs would be substantially higher. Education, monitoring, and investigation costs would be expected to increase as more GE crops become available.

Comments

Ag Commissioner: Looking at the CAC’s Pesticide Use Enforcement program as an indicator, a large portion of the enforcement costs go toward dealing with violations. It would be pointless to consider enforcement costs without planning for the potential of violations. After all, dealing with violators is the only way to show that the GE prohibition has “teeth” and is not just a hollow paper ban. Violations, investigations, and “due process” actions entitled to alleged violators will likely require the majority of the enforcement funds.

CCOF: The more specialized the enforcement, the higher the cost. On the other hand, if the enforcement is broad-based, then spot inspections of all producers becomes a realistic possibility and easier to handle.

Farm Bureau: State – marketing orders may have some authority to control production; County – Local marketing organizations could develop guidelines for production; Company – technical use agreements control crop production; there is also the potential for self regulation at the state or county level – co-existence guidelines.

GE Free: With a good program of education and outreach to farmers, along with cooperation from seed companies with our local laws, any enforcement costs could be kept to a minimum. As a final protection, the County Ag. Department could implement random testing of final produce. Until a violation was found, there would be absolutely no need to enter a farmer’s field or trespass on private property to enforce GE restrictions.

Issue or Concern	Potential actions by Board of Supervisors				
	Case 1	Case 2	Case 3	Case 4	Case 5
		Voluntary guidelines	Case-by-case	moratorium	Ban
Local Property Rights This issue includes both: Access to individual properties and commodities for the purposes of enforcement And to investigate actual commercial damage due to GE gene flow from neighboring properties See also impacts to producer’s choice in Ag Profitability	No explicit access without permission.	No explicit access without permission.	Case by case access for to enforce conditions of use. Notification of production might be a condition of use.	Potential for property rights violations during the enforcement of a temporary ban, depending upon the methods of enforcement chosen. Bob L. to review	Potential for property rights violations during the enforcement of a permanent ban, depending upon the methods of enforcement chosen.
Comments <u>Ag Commissioner:</u> When a farmer obtains an Operator Identification Number or a Restricted Materials Permit in order to use pesticides, they agree to allow the CAC to inspect the crops on their property, their relevant records, etc. This is what allows us to conduct inspections, take samples, investigate, etc.; if a grower does not use pesticides and does not need to obtain an OIN or RM Permit, we have no right to be on their property. What forms the basis for our right to conduct inspections for GE crops? Will we have to obtain permission each time beforehand? <u>CCOF:</u> If GE crops are banned (versus a moratorium), then undoubtedly someone will sue (with the support of the companies making the GE varieties). In addition, neighbors will sue those people growing the GE crops. Value of a moratorium is that it gives time for some of these issues to be sorted out. <u>GE Free:</u> With a good program of education and outreach to farmers, along with cooperation from seed companies with our local laws, any enforcement costs could be kept to a minimum. As a final protection, the County Ag. Department could implement random testing of final produce. Until a violation was found, there would be no need to enter a farmer’s field or trespass on private property to enforce GE restrictions.					

Issue or Concern	Potential actions by Board of Supervisors
Liability Issues	The use of patented genetically engineered (GE) crops presents specific legal risks that farmers must evaluate. Since courts are just beginning to address the complex legal and regulatory issues associated with these crops, the legal liabilities are still unknown. Tort liability (for damages, injury or wrongful acts) may arise in the case of farmers or seed distributors who are found responsible for contaminating fields. Tort liability can be based on any of several claims, each with its own legal definition dependent on the circumstances: trespass to land, nuisance, negligence or strict liability. In addition, seed contract liability, marketing contract liability, regulatory liabilities, and special liabilities for pharmaceutical crops are all items that need to be addressed. ^{xxii}
Comments <u>CCOF</u> : “Where genetically engineered crops are being cultivated in close proximity to organic production, the neighboring conventional farm growing these GE crops must accept the burden of legal and financial responsibility and liability for the effects of their GE crops on neighboring fields, animals and humans.” (CCOF line); issue of Canadian Percy Schmeiser vs. Monsanto <u>Farm Bureau</u> : Recourse – court system. Companies have been sued. Should there be more, such as liability insurance for the growers growing GE crops?	

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RESOURCE MATERIALS IDENTIFIED BY COMMITTEE MEMBERS –

[] Indicate committee resource for articles

Agricultural Issues

- California Agriculture. April-June 2004. This issue of California Agriculture examines the significant hurdles to commercial development for genetically engineered horticultural crops. In a future issue, California Agriculture will look at the benefits and risks of agricultural biotechnology. . <http://calag.ucop.edu/> [UCCE]
- Global Status of Approved Genetically Modified Plants. Biotech Crop Database. AGBIOS website. <http://www.agbios.com/dbase.php?action=Synopsis> [Ag Comm]
- Challenges and Opportunities for Horticultural Biotechnology. California Agriculture. April – June 2004 (58:2), pp 68-71. <http://calag.ucop.edu/> [Ag Comm]
- USDA National Organic Program: <http://www.ams.usda.gov/nop/indexIE.htm>

Pest Management:

- Current and Potential Impact for Improving Pest Management in U.S. Agriculture: An Analysis of 40 case Studies. National Center for Food and Agriculture Policy <http://www.ncfap.org/40CaseStudies.htm> [UCCE]

Resistance Management:

- Anonymous (2003) Testing two corn rootworm controls. Agriculture Research Magazine 51 4–6. [UCCE]
- Hardee DD *et al.* (2001) *Bt* Cotton and Management of the Tobacco Budworm-Bollworm Complex, ARS-154. Washington, DC: U.S. Department of Agriculture, Agriculture Research Service. [UCCE]
- Jian-Zhou Zhao, Development and Characterization of Diamondback Moth Resistance to Transgenic Broccoli Expressing High Levels of Cry1C, <http://aem.asm.org/cgi/content/abstract/66/9/3784> [GE Free]
- Western Producer, Feb. 10, 2000. Western Farm Press, Feb. 5, 2000 [GE Free]

Yield drag:

- Evidence of the Magnitude and Consequences of the Roundup Ready Soybean Yield Drag, By Dr. Charles Benbrook, <http://tinyurl.com/39buu>, http://www.biotech-info.net/RR_yield_drag_98.pdf [GE Free]
- Glyphosate-Resistant Soybean Cultivar Yields Compared with Sister Lines, <http://tinyurl.com/2rpgd>, <http://screc.unl.edu/Research/Glyphosate/glyphosateyield.html> [GE Free]
- King, C. et al. 2001 Agronomy Journal, 93, 179-186, 2001 [GE Free]

Economic Issues

- California at the Crossroads, page 3 – loss of export markets, page 4 – Market Rejections section, <http://tinyurl.com/yvjkc>, <http://www.greenpeaceusa.org/media/publications/califcross/wholedoc.pdf> [GE Free]
- California at the Crossroads, page 5 – threat to organic farming, <http://www.greenpeaceusa.org/media/publications/califcross/wholedoc.pdf> [GE Free]

Environmental Issues

- Saxena D Stotzky G (2001) *Bacillus thuringiensis* (Bt) toxin released from root exudates and biomass of Bt corn has no apparent effect on earthworms, nematodes, protozoa, bacteria, and fungi in soil. Soil Biology and Biochemistry, 33 1225-1230. [UCCE]
- Rieger MA *et al.* (2002) Pollen-mediated movement of herbicide resistance between commercial canola fields. Science 296 2386–2388 [UCCE]
- Cook, R. J. 2003. Biotechnology: Cause and Consequence of Change in Agriculture. in Agriculture National Agricultural Biotechnology Council Report 15: Biotechnology: Science and Society at a Crossroad http://www.cals.cornell.edu/extension/nabc/pubs/nabc_15/chapters/Keynote_Address-Cook.pdf [UCCE]
- Environmental Effects of Genetically Modified Food Crops, Margaret Mellon, Ph.D., J.D., Jane Rissler, Ph.D. <http://tinyurl.com/yw9bu>,

http://www.ucsusa.org/food_and_environment/biotechnology/page.cfm?pageID=1219
[GE Free]

Environmental Issues (cont.)

- Gone to Seed, Union of Concerned Scientists, <http://tinyurl.com/2b25v>,
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- Herman EM *et al.* (2003) Genetic modification removes an immunodominant allergen from soybean. Plant Physiology 132 36–43. [UCCE]
- Anonymous. June 11, 2001. Investigation of Human Health Effects Associated with Potential Exposure to Genetically Modified Corn. A Report to the U.S. Food and Drug Association from the Centers for Disease Control and Prevention.
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- What's Hiding in Transgenic Foods? Volume 80, Number 1, CENEAR 80 1 pp. 20-23, ISSN 0009-2347, <http://tinyurl.com/2kfpl>
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http://www.cals.cornell.edu/extension/nabc/pubs/nabc_15/chapters/Lumpkin.pdf [UCCE]

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Bt-maize (corn) during pollination, may trigger disease in people living near the
cornfield, <http://tinyurl.com/yry5h>, <http://www.seedsofdeception.com/Media-maizepollen.php> [GE Free]

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Genetically Engineered Organisms: Public Issues Education Project. Cornell Cooperative
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GENERAL INFORMATION

Biotechnology Regulatory Services. Animal & Plant Health Inspection Service. United States Department of Agriculture. <http://www.aphis.usda.gov/brs/>

University of California Biotechnology Website: <http://www.ucbiotech.org>

SLO GE Free Websites:

www.slogefree.org

www.calgefree.org

www.thecampaign.org

California Certified Organic Farmers: <http://www.ccof.org/>

USDA National Organic Program: <http://www.ams.usda.gov/nop/indexIE.htm>

Additional references of potential interest:

NABC Report 15: Biotechnology: Science and Society at a Crossroad (2003)

http://www.cals.cornell.edu/extension/nabc/pubs/pubs_reports.html#nabc15

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In Press but possibly a good read: Safety of Genetically Engineered Foods: Approaches to Assessing Unintended Health Effects Committee on Identifying and Assessing Unintended Effects of Genetically Engineered Foods on Human Health, National Research Council, National Academy of Sciences
332 pages, 6 x 9, 2004, <http://books.nap.edu/catalog/10977.html> [UCCE]

FOOTNOTE LINKS TO GE-Free COMMENTS

ⁱ Evidence of the Magnitude and Consequences of the Roundup Ready Soybean Yield Drag, By Dr. Charles Benbrook, <http://tinyurl.com/39buu>

ⁱⁱ Glyphosate-Resistant Soybean Cultivar Yields Compared with Sister Lines, <http://tinyurl.com/2rpgd>

ⁱⁱⁱ King, C. et al. 2001 Agronomy Journal, 93, 179-186, 2001

^{iv} California at the Crossroads, page 3 – loss of export markets, page 4 – Market Rejections section, <http://tinyurl.com/yvjkc>

^v Syngenta decides not to market GM product in the EU after all, <http://tinyurl.com/yvwwg3>

^{vi} California at the Crossroads, page 10 – increase in herbicide use

^{vii} Western Producer, Feb. 10, 2000. Western Farm Press, Feb. 5, 2000

^{viii} California at the Crossroads, page 10 – increase in herbicide use

^{ix} Jian-Zhou Zhao, Development and Characterization of Diamondback Moth Resistance to Transgenic Broccoli Expressing High Levels of Cry1C, <http://aem.asm.org/cgi/content/abstract/66/9/3784>

^x California at the Crossroads, page 5 – threat to organic farming

^{xi} Gone to Seed, Union of Concerned Scientists, <http://tinyurl.com/2b25v>

^{xii} Environmental Effects of Genetically Modified Food Crops, Margaret Mellon, Ph.D., J.D., Jane Rissler, Ph.D. <http://tinyurl.com/yw9bu>

^{xiii} Environmental Effects of Genetically Modified Food Crops, Margaret Mellon, Ph.D., J.D., Jane Rissler, Ph.D. <http://tinyurl.com/yw9bu>

^{xiv} Environmental Effects of Genetically Modified Food Crops, Margaret Mellon, Ph.D., J.D., Jane Rissler, Ph.D. <http://tinyurl.com/yw9bu>

^{xv} Monsanto defies German government on risk study as EU Commission prepares to approve GM maize, <http://tinyurl.com/2yz3r>

^{xvi} What's Hiding in Transgenic Foods? Volume 80, Number 1, CENEAR 80 1 pp. 20-23, ISSN 0009-2347, <http://tinyurl.com/2kfpl>

^{xvii} Filipino islanders blame GM crop for mystery sickness: *Monsanto denies scientist's claim that maize may have caused 100 villagers to fall ill*, <http://tinyurl.com/227w8>

^{xviii} Bt-maize (corn) during pollination, may trigger disease in people living near the cornfield, <http://tinyurl.com/yry5h>

^{xix} Environmental Effects of Genetically Modified Food Crops, Margaret Mellon, Ph.D., J.D., Jane Rissler, Ph.D. <http://tinyurl.com/yw9bu>

^{xx} The Unseen Genome: Gems among the junk. Scientific American, November 2003

^{xxi} 2004 Monsanto Technology/Stewardship Agreement, <http://tinyurl.com/yvjam>

^{xxii} Liability & Legal Issues, Californians for a GE Free Agriculture, <http://tinyurl.com/33kl4>